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Original Article

Dermatology Section

Onychomycosis in Qassim Region of Saudi Arabia: A Clinicoaetiologic Correlation

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ABSTRACT

Background: Onychomycosis is mainly caused by dermatophytes, but yeasts and nondermatophyte molds have also been implicated, giving rise to diverse clinical presentations. The aetiological agents of the disease may show geographic variation.

Aim: The aim of the present study was to isolate the causative pathogens and to correlate the various clinical patterns of onychomycosis with causative pathogens.

Materials and Methods: The study population comprised 170 patients with clinical suspicion of onychomycosis. Nail samples were collected for direct microscopic examination and culture. Clinical patterns were noted and correlated with causative pathogens.

Results: Out of total 170 cases included in the study, 140 (82.4%) were positive by microscopy and 77 (45.3%) showed positive mycological findings by both microscopy and culture. The male: female ratio was 1:2.5 and the mean age was 35.29 ± 16.47 years. Fingernails were involved in 51.9%, toenails in 28.6% and both fingernails and toenails in 19.5% of the 77 patients. The clinical types noted were distal lateral subungual onychomycosis (71.4%), proximal subungual onychomycosis (10.4%), total dystrophic onychomycosis (10.4%), superficial white onychomycosis (3.9%) and mixed pattern onychomycosis (3.9%). Yeasts were the most common pathogens isolated, being found in 36 patients (46.8%) followed by nondermatophyte molds which were isolated from 28 patients (36.4%) followed by dermatophytes which were isolated from 13 patients (16.9%).

Conclusion: Distal lateral subungual onychomycosis was the most common clinical presentation. *Candida albicans*, *Aspergillus species* and *Tricophyton rubrum* were the major pathogens. A single pathogen can give rise to more than one clinical type.

Keywords: Onychomycosis, Qassim region, Saudi Arabia

INTRODUCTION

Onychomycosis is fungal infection of the nail, characterized by thickening, splitting, roughening and discoloration of the nail [1]. It accounts for up to 50% of all nail diseases and 30% of all mycotic infections of nail [2]. This condition may affect toenails or fingernails, but toenail infections are particularly more common [3]. Studies indicate that adults are 30 times more likely to have onychomycosis than children [3]. The reported incidence of onychomycosis is 2-13% in North America [4] and 6.5% in Canada [5]. The prevalence rates of onychomycosis are 3-8% in the United Kingdom, Spain, and Finland [3]. Although onychomycosis is rarely life threatening, its high incidence and prevalence and the associated morbidity makes it an important public health problem. Reports are sparse on aetiology and incidence of onychomycosis in the Kingdom of Saudi Arabia.

Most studies on onychomycosis highlight the difficulty in the treatment of nail infections. The treatment is dependent on several variables, including the type of onychomycosis and the causative organism. Treatment failure occurs in 25-40 % of treated patients and the nail infections either do not respond or relapse after treatment. Prior to treatment an accurate diagnosis can provide guidance about the choice of antifungal agent, especially since the causative organism may vary in its response to available antifungal therapies [6]. At present, clinicians rely on clinical examination and a combination of direct microscopy (potassium hydroxide {KOH} examination) and fungal culture to achieve a diagnosis [7]. Immunohistochemistry techniques and DNA protocol are alternative methods for detecting onychomycosis infection. However, they need special instruments and may be costly [8].

As there are few data available on onychomycosis in the Qassim region of Saudi Arabia, we have carried out this study to find out various clinical patterns, aetiologic agents and to correlate the clinical patterns with causative pathogens.

MATERIALS AND METHODS

This was a prospective study. One hundred and seventy clinically suspected cases of onychomycosis attending the out-patient dermatology clinics affiliated with College of Medicine, Qassim University, Saudi Arabia were included in the study. The study was carried out from May 2012 to October 2013. A detailed history of trauma, occupation, sharing of common facilities, age, personal habits such as smoking and drinking, personal hygiene, hyperhidrosis and different predisposing diseases e.g. diabetes were collected. Patients on systemic antifungal therapy within the last four weeks or topical antifungal therapy within the last one week were excluded from the study. Different clinical patterns of onychomycosis were noted. Clinically, the disease was classified as follows: (i) DLSO: if there was onycholysis, discoloration, subungual hyperkeratosis, and thickening affecting the distal and/or lateral nail; (ii) PSO: if discoloration and onycholysis affected the proximal part of the nail; (iii) SWO: when white opaque spots were seen on the nail surface with textural changes; (iv) TDO: if there was involvement of the entire nail bed and nail plate; (v) MPO: if there was mixture of above types. The most severely affected nail was selected for specimen collection. The selected nail was cleaned with 70% alcohol to remove contaminants. As sites of invasion and localization differ in different varieties of onychomycosis, different approaches were taken to collect the nail specimens. Samples were collected as nail cut, nail clippings or nail debris and directly sent to be examined

in the mycology laboratory in the College of Medicine, Qassim University. All specimens were subjected to direct microscopy with 20% KOH solution to determine the presence of fungal elements. All specimens were inoculated into Sabouraud's dextrose agar (plain), Sabouraud's dextrose agar with antibiotic, Sabouraud's dextrose agar with antibiotic and 5% cycloheximide. Specimens were also inoculated into dermatophyte test medium. The inoculated screw-cap bottles were incubated in a B.O.D. incubator at 25-30°C for 1-4 weeks. The pathogenic organisms were identified by gross morphology and microscopic examination with KOH and lactophenol cotton blue preparation. If a dermatophyte was isolated in culture, it was taken as a pathogen. If a nondermatophyte mold or yeast was isolated, it was considered to be significant if they were isolated repeatedly in pure culture (three times) on two media and with a positive KOH finding [9]. To identify *Candida albicans* we did germ tube test and corn meal agar inoculation. We also did urease test to differentiate *Trichophyton* species.

The study protocol was approved by the Ethics Committee of College of Medicine, Qassim University. The SPSS for statistical analysis were applied by using t-test for comparison of measurement data and a Chi-square test for comparison of enumeration data.

RESULTS

Out of total 170 consecutive cases included in the study, 140 (82.4%) were positive by microscopy and 77 (45.3%) were positive by both microscopy and culture. The demographic data of 77 patients mycologically confirmed by both microscopy and culture is presented in [Table/Fig-1]. Females outnumbered males by 2.5 to one. Analysing the prevalence of onychomycosis in different age groups showed that the patients ranging from 11 to 50 years (72.7%) were most commonly affected. Disease was associated with diabetes in 15 (19.5%) patients, with a history of trauma in five (6.5%) and with psoriasis in two (2.6%) patients.

[Table/Fig-2] shows the various clinical types and sites of nail involvement. Forty (51.9%) patients had fingernail involvement alone, while 22 (28.6%) patients showed only toenail involvement. Fifteen (19.5%) patients had both fingernail and toenail involvement. DLSO was the most common clinical type, seen in 55 (71.4%) patients, followed by PSO (8 patients; 10.4%), TDO (8 patients; 10.4%), SWO (3 patients; 3.9%) and MPO (3 patients; 3.9%).

The spectrum of fungal isolates recovered from nail scrapings is illustrated in [Table/Fig-3]. Of the 77 organisms identified, yeasts were isolated in 36 (46.8%) patients. Among the yeasts, *Candida albicans* was isolated in 31 (40.3%) patients. Nondermatophyte molds were isolated in 28 (36.4%) patients. Among the nondermatophyte molds, *Aspergillus species* was isolated in 23 (29.9%) patients. Dermatophytes were isolated in only 13 (16.9%) patients. Among the dermatophytes, *Tricophyton rubrum* was seen in 9 (11.7%) patients.

The correlation between various isolated pathogens and the clinical type is depicted in [Table/Fig-4]. The most common clinical presentation of onychomycosis was DLSO, in 55 patients (71.4%). DLSO was caused by *Candida albicans* in 19 patients (34.5%) and by *Aspergillus species* in 17 patients (30.9%).

Age (years)	Males (n = 22)	Females (n = 55)	Total (n = 77)
< 10	1	5	6
11–20	3	8	11
21–30	6	6	12
31–40	1	18	19
41–50	8	6	14
> 50	3	12	15
Range (years)	5–58	1–69	1–69
Mean (years)	35.04 ± 14.64	35.40 ± 17.27	35.29 ± 16.47
Occupation			
Housewife/unemployed	0	37	37
Office worker	13	5	18
Student	3	10	13
Laborer	5	0	5

[Table/Fig-1]: Demographic data of patients positive for microscopy and culture

	Fingernail (n = 40)	Toenail (n = 22)	Fingernail and Toenail (n = 15)	Total (n = 77)
DLSO	26	19	10	55
PSO	6	1	1	8
SWO	2	1	0	3
TDO	4	1	3	8
MPO	2	0	1	3

[Table/Fig-2]: Clinical types and sites of involvement

	Fingernail (n = 40)	Toenail (n = 22)	Fingernail and Toenail (n = 15)	Total (n = 77)
Dermatophytes				
Tricophyton rubrum	4	4	1	9
Tricophyton verrucosum	2	1	1	4
Yeasts				
Candida albicans	20	2	9	31
Candida parapsilosis	1	3	0	4
Rhodotorula species	0	1	0	1
Nondermatpphyte molds				
Aspergillus species	13	8	2	23
Fusarium species	0	2	0	2
Bipolaris species	0	1	1	2
Cladosporium species	0	0	1	1

[Table/Fig-3]: Isolates from the cases of onychomycosis

	DLSO (n = 55)	PSO (n = 8)	SWO (n = 3)	TDO (n = 8)	MPO (n = 3)	Total (n = 77)
Dermatophytes						
Tricophyton rubrum	8	0	1	0	0	9
Tricophyton verrucosum	4	0	0	0	0	4
Yeast						
Candida albicans	19	5	0	4	3	31
Candida parapsilosis	3	0	0	1	0	4
Rhodotorula species	1	0	0	0	0	1
Nondermatpphyte molds						
Aspergillus species	17	3	2	1	0	23
Fusarium species	2	0	0	0	0	2
Bipolaris species	1	0	0	1	0	2
Cladosporium species	0	0	0	1	0	1

[Table/Fig-4]: Clinicoetiologic correlation

DISCUSSION

Onychomycosis is a fungal infection of the nails, mainly caused by dermatophytes, but yeasts and nondermatophyte molds also play a major role in its aetiology [10]. Although not life threatening, it can have some negative impact on the patients' social, emotional and occupational functioning [11]. As people are gradually becoming more conscious about their health and looks, there has been a recent increase in the incidence as well as the spectrum of positive pathogens associated with onychomycosis [12].

Onychomycosis is usually asymptomatic; therefore, patients usually present for cosmetic reasons without any physical complaints. As the disease progresses, patients may report paresthesia, pain, discomfort and loss of dexterity and onychomycosis may interfere with standing, walking, and exercising. A careful history may reveal many environmental and occupational risk factors [3]. The causative pathogen and incidence of onychomycosis depend on age, gender, geographic and climatic conditions, living habits, and immune status of the host [13]. The microbiological identification of onychomycosis may be uncertain as some fungi growing in culture are not necessarily pathogen and invasive. Conversely, the negativity of a culture is not rare even when fungi are seen by microscopy [14]. Clinically onychomycosis is subclassified into various forms such as distal lateral subungual onychomycosis (DLSO), superficial onychomycosis (white or black) (SO), proximal subungual onychomycosis (PSO), endonyx onychomycosis (EO), mixed pattern onychomycosis (MPO) and total dystrophic onychomycosis (TDO). Total dystrophic onychomycosis refers to the most advanced form of any subtype [3].

Disease is known to occur at any age, but is more common between 40 and 60 years of age and is unusual prior to puberty [3]. The majority of our patients (72.7%) were between the ages of 11yrs and 50yrs. This is in accordance with reports by Bokhari et al., [15] and Garg et al., [16] but contrasts with the findings of other reports [17,18]. There were only six children (<10 years), highlighting the fact that this disease may be less common in this age group, even in our community. A sizeable number (40.3%) of our patients were between 21 and 40 years of age; this could be attributed to the fact that onychomycosis may be considered a cosmetic problem rather than a disease process in this region, and so it is younger patients who are more conscious of their appearance, who come forward for therapy.

Our data suggest that more females than males were affected by onychomycosis (71.4%:28.6%), and the prevalence was highest in adult females aged between 21 and 69 years [Table/Fig-1]. These results are in agreement with those of earlier investigators, who also reported a higher prevalence of onychomycosis in females than males [19,20]. By contrast; some studies have reported onychomycosis in males more than females [16,21]. Difference in the prevalence of onychomycosis in males and females in the Arabian Gulf may be attributed to the vast difference in lifestyle and propensity to micro-trauma [22]. In this region of Saudi Arabia, the majority of women are confined to household activities, including childcare, laundry, and cooking, etc. Men are generally considered as the “bread winners” and spend significant time in the workplace. With regards to occupation, majority of our patients were housewives [Table/Fig-1].

DLSO was the most common clinical presentation of onychomycosis in our patients (71.4%), followed by PSO (10.4%), and TDO (10.4%). SWO (3.9%) and MPO (3.9%) were comparatively rare events [Table/Fig-2]. Similar observations have been reported previously [16,23]. DLSO was evenly distributed between fingernails and toenails while PSO, TDO, SWO and MPO were observed more in fingernails. This finding is in accordance with reports by Bokhari et al., [15] and Velez et al., [24].

In our patients, the frequency of dermatophytes causing nail infections was quite low (16.9%) whereas yeasts (46.8%) and nondermatophyte molds (36.4%) were the most common causative agents [Table/Fig-3]. Nondermatophyte molds were considered to be clinically significant in this study because they were isolated repeatedly in pure growth in the absence of any dermatophyte [25]. Other studies have also reported yeasts and molds as the predominant pathogens involved in onychomycosis [15,20]. Among the dermatophytes, *T. rubrum* (11.7%) [Table/Fig-3] was the most common organism found, as reported for other countries including Finland [17], Spain[18], UK [26,27] and USA [28]. The high prevalence of *T. rubrum* has been explained by its better adaptation to the hard keratin of nails [15]. *T. verrucosum* (5.2%) as a causative agent of onychomycosis has rarely been reported previously. *T. verrucosum* causes various lesions in cattle and humans. The lesions in humans are found chiefly on the chin, neck and wrist, and on the back of the hand [29]. Incidental exposure to cattle may account for the cases in our study.

Among the Yeasts, *Candida albicans* were the most common isolates, and the most favorable site of infection was the fingernails [Table/Fig-3]. Our results are in agreement with the observations in other regions of Saudi Arabia, where the highest prevalence of *Candida* infection has been reported in the nails [20,30]. Yeasts may colonize the skin, hair, and nails, and may become pathogenic in association with pre-existing infection, trauma, loss of epidermal barrier function, or immunodeficiency [31].

Of the nondermatophyte molds, *Aspergillus sp*. was the most common etiologic agent causing onychomycosis in our study [Table/Fig-3], and similar results have been reported from other parts of the world, such as Pakistan [15], Cameroon [32], Spain [33], Brazil [34], Italy [35] and Poland [36]. Although nondermatophyte molds are usually considered to be nonpathogenic, their pathogenicity should not be underestimated, as molds such as *Aspergillus sp*. or *Fusarium spp*. may be life-threatening for immunosuppressed patients with HIV infection, organ transplant recipients, or individuals receiving cancer chemotherapy [37].

In our study, DLSO, PSO, TDO, and SWO were seen both in fingernails and toenails, while MPO was seen only in fingernails [Table/Fig-2]. The clinicoetiologic correlation [Table/Fig-4] revealed that a single pathogen could give rise to more than one clinical type. DLSO was the usual manifestation of yeast, nondermatophyte molds and dermatophyte infections; however, PSO and TDO were also seen in a sizeable number of patients, and SWO and MPO were occasionally encountered. None of the patients with dermatophyte infection presented with PSO, TDO and MPO. *Candida albicans* presented as DLSO in a large number of patients and also presented as PSO, TDO and MPO in a small number of patients. SWO was not seen in any patient of *Candida albicans* group. *Aspergillus sp.* mostly presented as DLSO but PSO, SWO and TDO were occasional presentations.

LIMITATIONS

- Study population is small.
- Photographs of different presentations are not available.

RECOMMENDATIONS

- The health education system needs to improve knowledge about onychomycosis among the people by means of improving educational tools.
- Isolation of the pathogen by culture before oral therapy is advised to optimise treatment.
- Provision of diagnostic facilities of onychomycosis in primary health care centers.

CONCLUSION

The study clearly shows that yeasts and nondermatophyte molds constitute the major pathogens causing onychomycosis in Qassim region of Saudi Arabia however, dermatophytes were also isolated from affected nails. Among the yeasts, *Candida albicans* was the most prevalent pathogen. *Aspergillus species* was the major pathogen among nondermatophyte molds and *T. rubrum* was major

pathogen in dermatophytes group. A single pathogen can give rise to more than one clinical pattern of nail involvement. Any morphologic form of onychomycosis can be caused by more than one organism. It is not possible to identify the causative fungus by merely looking at the diseased nail, and hence isolation of the pathogen by culture before oral therapy may be advisable to optimise treatment.

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